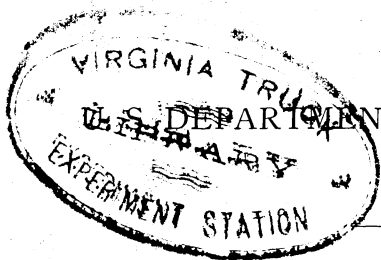


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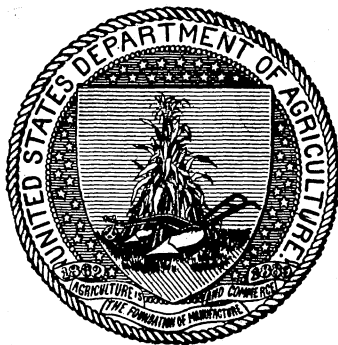
FARMERS' BULLETIN 347.

THE REPAIR OF FARM EQUIPMENT.

BY

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U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF PLANT INDUSTRY,
OFFICE OF THE CHIEF,
Washington, D. C., April 2, 1908.

SIR: I have the honor to transmit herewith a manuscript entitled "The Repair of Farm Equipment," by Mr. W. R. Beattie, Assistant Horticulturist, and recommend that it be published as a Farmers' Bulletin.

The proper care of farm equipment is a matter of great importance, not only to obtain the greatest efficiency of the machinery and implements, but also to lengthen their period of service and lessen the cost of maintenance.

Respectfully,

B. T. GALLOWAY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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THE REPAIR OF FARM EQUIPMENT.

INTRODUCTION.

The successful management of a modern farm depends largely upon the efficiency of the equipment with which the work is performed. The equipment of the average farm can be divided into about three more or less distinct classes, as follows: First, and most important, are the buildings, fences, implements, machinery, wagons, and all appliances used in the more important farming operations; second, utensils and machinery used in connection with the dairy, garden tools, butchering outfit, and the numerous small things for general use about the place; third, the tools, materials, and facilities for keeping the first two classes of equipment in repair and in good working order. It is with the last class that this paper has to deal, the object being to assist the farmer in the selection of a suitable tool outfit, to suggest a line of supplies that are most commonly required for making repairs, and to give hints regarding the proper care and uses of tools.

In order to secure the greatest efficiency, all implements and machinery should be properly housed when not in actual service, so as to be in good working condition when required for use. Alterations and repairs on buildings and fences are required from time to time to accommodate them to changed conditions and to protect the crops. Farm machinery and equipment generally are subject to wear and breakage, and constant attention to repairs is necessary. The extent to which the repair work should be done on the farm will depend entirely upon local circumstances. If there is a well-equipped shop near-by where the repair work can be done by a trained mechanic without loss of time it may be best to carry the greater part of such work to the shop; but if the shop is at a distance, is poorly equipped, or, as is often the case, the mechanic in charge is incapable of turning out good work, it will then be a saving to perform the work at home. Besides, there is a large amount of repair work that can not be carried to a shop and must be done on the farm if it is done at all.

The importance of making repairs promptly.—Breakdowns are most frequent during the busy season, and much valuable time may be lost

in going to some distant shop for repairs or in waiting until a new part of some machine or implement can be secured. In many cases an accident to one of the farm implements will cause the loss of not only a portion of the crop but also the time of a number of farm hands until repairs can be made and work resumed. Permanent repairs can frequently be made at once, and under most circumstances temporary repairs, at least, can be made, provided the necessary tools and supplies are at hand.

The economy of making repairs on the farm.—The question as to how far to undertake to do repair work on the farm will depend considerably upon the personality of the farmer himself and his capability to handle tools and execute the work. The regular work of the farm should be the primary consideration, and any repair or construction work that will cause the neglect of crops should not be undertaken. By the aid of a little training, together with the necessary tools and supplies, the farmer can repair all ordinary injuries to the farm equipment; and as a rule he can do this in a shorter time than would be required to go to a distant shop. If it were not for the economy of time, repairs made in a regular shop and by a trained mechanic would generally be found more satisfactory than those made at home, but the saving in both time and expense renders the repair outfit an important adjunct to the farm equipment.

The time for making repairs.—Much of the loss and annoyance from breakage may be avoided by carefully inspecting and mending weak parts of the farm equipment before the rush of the season's work begins. The proper time for making such repairs as may be anticipated is during the winter months and at times when the regular farm work is not pressing. As the season advances the implements that will be required for the next farming operations should be gotten out, gone over, and given any attention required to make them ready for immediate use. If the farm machinery is not properly housed through the winter or during other periods of disuse, then it is all the more important that it should be given a careful overhauling. After inspecting an implement, tightening bolts, strengthening weak parts, and renewing broken pieces, any necessary painting should be done. Frequent applications of dark red metallic paint, consisting either of red lead or Venetian red and raw linseed oil, not only improve the appearance of many of the farm implements but add greatly to their lasting qualities. This is an age when appearances count for much, and a farmer's standing in the community is frequently governed by the appearance of his farm equipment. The man who spends his spare moments in the repair of fences and gates and in maintaining a neat appearance of the entire farm will easily be a leader among his neighbors.

The educational value of the use of tools.—The use of tools is of great value as an educational feature, especially when the work is carefully performed. The boys on the farm should be encouraged in the use of tools, but should be held responsible both for the care of the tools and the character of the work performed with them. The tool outfit of the farm is of special service on stormy days and will aid greatly in keeping the boys employed and contented to remain at home.

Before beginning any piece of work, a definite plan should be worked out in detail, and if it requires the assembling of several parts each piece should be sketched on paper or on a board, so that when finished a close fitting of parts will be assured. It may be well to add a word of caution regarding the improper use of tools, for constant tinkering will work more harm than good. If a bolt is tight, that is sufficient, and an extra turn with the wrench may strip the threads and cause trouble. The taking apart of machinery should be avoided, except in cases where it is absolutely necessary to do so. The reaper and mower and other machines of this class are securely put together at the factory, and if the parts are removed it is difficult to restore them to their proper adjustments.

It is doubtful whether horseshoeing,^a wheelwright work, and repair work which requires special machinery can be economically performed on the farm, except where the farming operations are sufficiently extensive to justify the establishment of a shop and the employment of a mechanic.

TOOLS ADAPTED TO REPAIR WORK ON THE FARM.

The selection of the tool outfit will depend upon the scope and character of the work to be performed.

On most farms there is a deficiency of suitable repair tools and supplies, and an increased investment along this line is strongly recommended. Some farmers, however, need to be cautioned against hasty, indiscriminate purchases. A small, well selected outfit, used to the best advantage and well cared for, will prove more satisfactory than a large miscellaneous assortment improperly kept and used.

In this bulletin no attempt is made to determine the extent of the repair outfit which the individual farmer should purchase or the amount and scope of the work he should undertake. The problem is one for each farmer to solve, as he alone is familiar with all the conditions. The aim here is to furnish information which will be useful to farmers of all classes in selecting repair outfits, whether

^a For information on horseshoeing, see Farmers' Bulletin No. 179, which will be sent free upon request to the Secretary of Agriculture.

they be large or small, leaving each farmer to decide the extent to which he should purchase and use the tools and supplies listed.

In nearly all localities most of the tools may be purchased from the local hardware dealer. In many places there are stores known as "farmers' supply houses" from which many of the more common tools may be purchased. In addition to these, many of the manufacturers of tools offer combination outfits, and the large "mail-order" houses of the country are prepared to supply tools of all kinds, either singly or in combinations. A number of tools and appliances described herein are not ordinarily found in the regular stores, and these can be made either by a local mechanic or on the farm.

Under most circumstances it will pay to secure tools of good quality, although fine exterior finish is not essential. Tools of very inferior quality are offered at low prices, but they invariably prove a disappointment to the purchaser. The name of the manufacturer is a sufficient guaranty of the quality of many tools, and the purchaser is advised to secure only those that are sold under a guaranty from either the manufacturer or the dealer. When contemplating the purchase of a collection of tools, make a careful study to see just what ones are needed, then purchase all at one time, and a liberal discount can generally be secured.

For the convenience of intending purchasers in making up a set of tools, lists with descriptions of those most commonly required on the farm are here given; also suggestive combinations varying in price from \$2.50 to \$25. In describing the tools, they have been divided into classes, including wood-working, iron-working, miscellaneous; and general-purpose tools, and special conveniences for repair work. In making up the lower priced combinations, preference is given to the tools required for the more simple operations and having a broad range of utility.

WOOD-WORKING TOOLS.

In the case of certain tools more than one shape or style is offered by dealers. In a few cases a particular type of tool is better adapted to use on the farm than others, and these differences are mentioned in connection with the following list.

Ax.—An ax is perhaps one of the first tools required upon a farm. The ax properly belongs to the regular farm equipment, but inasmuch as an ax which is used for general purposes on the farm is rarely in condition for use in making repairs, it is recommended that at least two axes be on hand, one to be kept in first-class condition and to be used for repair and construction work alone. Axes are of various grades and range in price from 75 cents to \$1.50. Axes also vary in

weight between 2 and 5 pounds, $4\frac{1}{4}$ or $4\frac{1}{2}$ pounds being a good size for general use. It always pays to secure a good ax, and a hand-made hickory handle is to be preferred to the cheaper machine-made ones.

Hand ax.—The tool commonly known as a hand ax is similar to a large hatchet or, rather, is a compromise between a hatchet and a broadax. The blade of the hand ax is ground on one side only, and it is especially adapted for use in hewing the side of a post and for “roughing out” doubletrees, tongues, and similar parts of machinery.

Hatchet.—A hatchet is almost indispensable on the farm, even where the tool outfit is very limited. There are several styles and shapes of hatchets on the market, the half-hatchet (fig. 1, *B*) being perhaps the most serviceable type. There is no tool where quality counts so much as in the hatchet; however, a good one can be secured for about 75 cents.

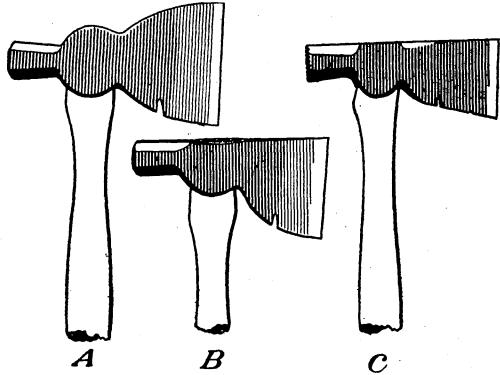


FIG. 1.—Three types of hatchet. The half hatchet (*B*) is best adapted for general farm use.

Handsaws.—A good handsaw is almost as important on the farm as an ax or a hatchet. A crosscut saw, having regular V-shaped teeth, is most often required, but a ripping saw will be desirable where a large amount of lengthwise sawing is to be done. The difference in the shape of the teeth of the crosscut and ripping saws is shown in figure 2.

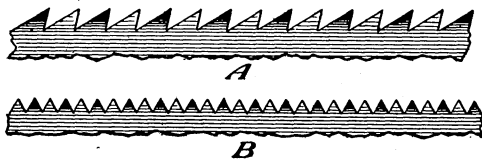


FIG. 2.—Saw teeth : *A*, ripping saw ; *B*, crosscut saw.

A crosscut saw for general farm purposes should not be too fine, one having about 8 teeth to the inch being desirable. If more than one saw of this class is kept, the collection should include a No. 7 or No. 8 for the rougher work and a No. 11 for finer cutting. A large-toothed crosscut saw can readily be used in place of a ripping saw, especially if the teeth are filed a trifle on the order of those of the ripping saw.

The proper sharpening of saws is essential, and unless one has had considerable experience it will be desirable to have this work performed by a trained mechanic. The saw-sharpening outfit consists of two thin boards between which the saw blade can be clamped

in the vise or workbench clamp, a "set" for use in giving the teeth of the saw the proper spread, and a small three-cornered file. First go over the teeth of the saw with the "set" and open them just enough to give the blade clearance in the wood, being careful to spread the teeth in the same direction as they were originally. After having properly opened the teeth proceed to sharpen them with the small three-cornered file. Hold the file with both hands, at a slight angle with the saw, and draw it about twice through each notch between the teeth. File one side of the saw at a time, skipping every other notch; then reverse the blade and file the other side. It should be the aim to retain the shape and pitch given the teeth in the factory.

Compass saw.—The compass, or bracket, saw is a narrow saw blade tapering to a point. The principal uses of a compass saw are for cutting curved surfaces for the timber parts of implements, sawing circular openings, and sawing a slit from an auger hole in which the regular handsaw may be started.

Steel square.—For most purposes a square having a length of 24 inches on one arm and 16 or 18 inches on the other arm will be found satisfactory. For lighter work a medium-sized square is convenient, and for very small and careful marking the try-square, measuring about 4 by 6 inches, is desirable. The standard-size square will be found most important, and this can be secured at prices ranging from 75 cents to \$1.50, or even higher. A small try-square can be purchased for 25 or 30 cents.

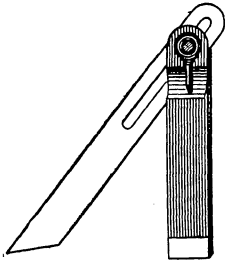


FIG. 3.—Bevel square.

Bevel square.—The bevel square (fig. 3) is a device one blade of which can be set at any angle to the other. This tool is useful where a number of pieces of material are to be cut to a given slope, the siding for the gable end of a building being a good example. The cost of a bevel square should be about 40 cents.

Drawing knife.—The uses of this implement on the farm are too well known and numerous to require mention. The essentials of a serviceable drawing knife are good steel in the blade and substantial handles securely riveted. A first-class drawing knife adapted to general purposes can be secured for about \$1.

Brace and bits.—For boring holes not exceeding $1\frac{1}{4}$ inches in diameter, a brace and a set of bits are essential. There are several types of brace upon the market. The simpler forms can be secured for 40 or 50 cents each, while the more elaborate types with ball bearings and ratchet shank frequently sell as high as \$2.50. For ordinary work the cheaper form of plain brace will answer, but for boring in close

quarters a ratchet brace that will work without turning the handle completely around is desirable.

The bits for use in the brace can be secured singly or in sets of 6, 8, or 12, including sizes ranging from one-fourth inch to 1½ inches. A set containing eight bits will answer practically every requirement on the farm. The set containing twelve bits includes sixteenth-inch sizes and can be secured at prices from \$2.50 upward. The brace and a full set of bits should not cost more than \$5.

Gimlet bits.—For boring small holes in wood, especially for the insertion of wood screws, an assortment of gimlet bits is desirable. The uses of the gimlet bits are limited, however, and their place may be filled by the small sizes of twist drills which may be used for boring either wood or metals.

Screw-driver bit.—For setting wood screws in hard wood or for the removal of old ones there is nothing equal to a square-shank screw-driver that may be used in the brace. This little tool can be made from the shank of a broken carpenter's bit, from an old file, or a small piece of steel, or it can be purchased for 10 cents.

Screw-driver.—The common hand screw-driver is especially desirable for use about the dwelling and for light work on machinery. In order that a screw-driver should give good service it is essential that the metal part should consist of good steel and that it should extend through the handle and be securely riveted. The handle should also be protected from splitting by means of bands or rivets. This type of tool can be secured at prices ranging from 25 to 75 cents, according to size and quality.

Augers.—For boring holes larger than 1½ inches in diameter it will be necessary to secure regular augers having T-style handles. By having the square shank of the augers of the same size and provided with a thread and nut at the end, one handle can be made to serve for all. There are handles on the market which are provided with an iron plate and thumbscrew for clamping to the auger shank.

If the cutting edges of an auger or a bit become dull, they may be sharpened with a small file. To merely sharpen an auger, file on the lower side of the cutting edges, being careful to keep them of the same pitch or bevel. In case a bit does not take sufficient hold, first see that the threads on the center point are clean; if the difficulty is not with the threads, then file the upper side of the cutting edges a little.

Jack plane.—The name "jack plane" is applied to that class of planes that are suited for general purposes, especially for rough work. The old form of wood-body jack plane with its wedge-set bit has been largely replaced by the more modern iron or combination wood and

iron plane, with spring clamp and thread feed to regulate the bit. A very good 14-inch jack plane can be bought for \$1.50.

Smoothing plane.—This tool is similar to the jack plane except that it is smaller and is designed for imparting a smooth finish after the rougher surface has been removed. The cost of a smoothing plane will be about \$1.25.

In grinding the bit of a plane care must be taken to keep the edge square and to prevent the corners from becoming rounded. It is well to have a small square at hand and try the edge from time to time while grinding. After grinding the plane bit always finish on an oilstone, smoothing off any burr or rough edge that has been formed in grinding. Do not grind the plane bit every time it loses its keen edge, but simply whet it on the oilstone; grind it only when the oilstone fails to give a cutting edge. In resetting the bit in its place, first have the cutting edge of the bit a little higher than the lower surface of the plane, then after clamping it in place gradually feed it downward until the proper depth of cut is reached.

Wood chisels.—A number of chisels of sizes from one-half inch to 1½ inches are desirable. The type known as "socket and firmer," with a leather tip on the wood handle, is the best for general purposes. The price will vary with the size and quality from 25 cents to \$1.50 each. A wooden mallet should be used for driving the chisels.

Claw hammer.—This common type of hammer is desirable for use around the house and outbuildings. The principle of construction gives great leverage for drawing nails. If a spike or long nail is to be drawn, the efficiency of the claw will be greatly increased by placing a rounded block of wood between the hammer and the plank from which the nail is being drawn. A medium-grade claw hammer can be secured for about 50 cents, but one of the highest quality will cost 90 cents to \$1.

Claw bar.—Where a great many large nails are to be drawn or where old buildings are to be torn down, there is nothing superior to a claw

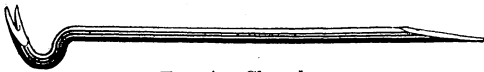


FIG. 4.—Claw bar.

bar (fig. 4). This tool can be made by any blacksmith from a piece of three-fourths or seven-eighths

inch steel about 3½ feet in length. One end should be shaped somewhat like the claw of a hammer with a wedge-shaped slit for taking hold of nails. The opposite or handle end may be drawn to a chisel point, and serve as a bar for the prying apart of materials; or if drawn to a sharp point it is very useful for drawing staples. The length of handle and short fulcrum of this tool give a powerful leverage when applied to the pulling of spikes or bolts.

Spokeshave.—The spokeshave (fig. 5), sometimes called a scraper, has been in general use for a long time and is still one of the most useful tools, especially in the finishing of handles or anything that is shaved from wood. A good one can be purchased for 40 cents.



FIG. 5.—Spokeshave, or scraper.

Wood rasp.—The wood rasp is similar to a coarse file and is used for finishing any piece of wood which requires to be brought to a definite size. A wood rasp is desirable for use in fitting the handles of picks, mattocks, or hoes to their sockets. A 14-inch wood rasp will answer general purposes and should cost about 35 cents.

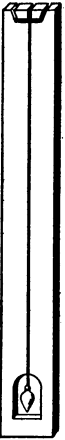


FIG. 6.—Plumb rule made from a piece of board.

Folding rule.—Where some measuring device is frequently wanted, a folding rule that can be carried in the pocket will be found very convenient. Folding rules are made in lengths from 1 to 5 feet and can be secured as cheaply as 10 cents each, but one that will prove durable will cost 35 or 40 cents.

Chalk line.—Any hard-twisted string will serve as a chalk line. Cord made especially for this purpose can be secured for 10 or 15 cents a ball. Chalk for use on the line can be purchased for 5 cents a ball, or about 15 cents a pound. A

chalk line is especially desirable for securing a straight cut through a plank having irregular edges and in “laying off” a tapering tongue or similar part of farm machinery.

Plumb rule.—A plumb rule is desirable for use in construction work and is also adapted to the setting of posts. A device of this kind (fig. 6) can be made from a piece of board, a bob, and a string.

Spirit level.—This implement will be found useful for a great many purposes. The most common form of spirit level consists of a bar of wood with a spirit tube mounted near the center.

In the better grades a plumbing tube is inserted near one end. Levels of this kind cost from 40 cents to \$1.50 each. There is a small, or

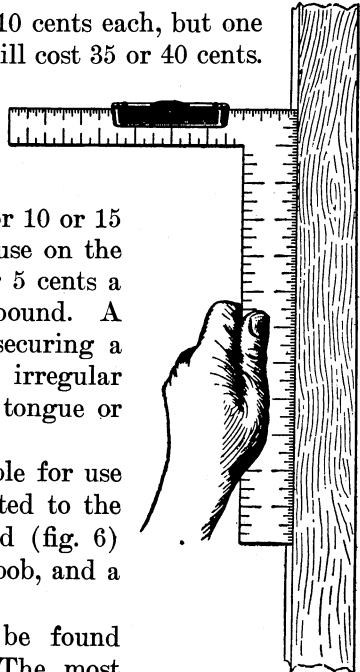


FIG. 7.—Spirit level used as a plumb.

pocket size, level (fig. 7) that is adapted for fastening on a steel square and may be used either for leveling or plumbing purposes. This form of level can be bought for 15 or 20 cents.

TOOLS AND EQUIPMENT FOR WORKING IRON.

The following list, together with short descriptions, includes the majority of the tools that will be required for handling metals in the repair of farm equipment. There are a few tools that are equally useful for working with both wood and metals; for instance, twist drills may be employed for boring almost any kind of material.

Riveting hammer.—A good riveting hammer is essential on every

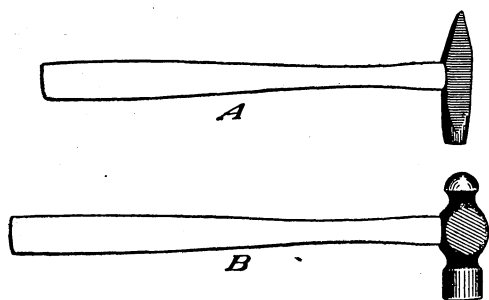


FIG. 8.—Riveting hammers: A, ordinary riveting hammer; B, machinist's hammer.

farm where modern machinery is used. There are two types of riveting hammer in general use (fig. 8), one having one end of wedge shape and the other type (known as a machinist's hammer) having a round end for riveting purposes. The hammer having the wedge-shaped riveting end is

generally considered best for farm purposes.

Monkey wrench.—A monkey wrench frequently accompanies one or more of the farm machines, but as this is one of the most important repair tools an extra one will not come amiss. The size of this tool is determined by its length in inches, a 12-inch monkey wrench being adapted for most purposes. The type of wrench having the wood handle in two parts and riveted to the central iron handle is most serviceable. A 12-inch monkey wrench will cost about 60 cents.

Solid or end wrenches.—For many purposes the solid type of wrench (fig. 9) with end jaws fitted to the various sizes of bolts and nuts is desirable. Those made somewhat in the shape of the letter S are adapted to working in close places and are not likely to slip. These wrenches may be purchased at prices ranging from 7 to 35 cents each, or they may be made from steel and slightly hardened.

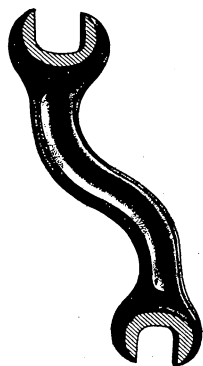


FIG. 9.—Solid, or S, wrench.

Alligator wrench.—The alligator wrench is very desirable for holding a round-headed bolt or rod of iron; also for turning nuts that are inaccessible for an ordinary wrench. Alligator wrenches having

one jaw adjustable are obtainable, but the form having both jaws rigid is somewhat cheaper. The cost of a small alligator wrench will be anywhere between 15 and 60 cents, according to quality and finish.

Pipe wrench.—A pipe wrench of 10-inch or 12-inch size is quite desirable for use in making repairs upon farm machinery. The pipe wrench (fig. 10) is adapted for turning or holding iron pipe, rods, or bolts. It is essential to have one or more pipe wrenches on farms where a water supply under pressure and general plumbing appliances are maintained; however, wrenches for pipe fitting should as a rule be somewhat larger than those used for repair work on machinery. The cost of a small pipe wrench suitable for repair work should be about \$1. Neither the pipe wrench nor the alligator wrench should be used extensively for turning the nuts of bolts, as the teeth of these wrenches tear and injure the nuts.

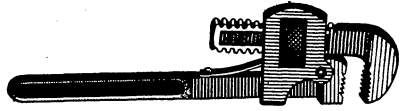


FIG. 10.—Pipe wrench.

Punches.—An assortment of punches, including several sizes and kinds, should be kept on hand. The round, solid-point punch, adapted to such work as punching out the rivets of the ordinary mowing-machine knife, is the most important, although those having square and taper points are frequently required. The collection should include a center punch having a blunt, sharp point for marking metals before drilling.

An assortment of punches may be purchased at a cost of from 10 to 40 cents each, or they may be made from tool steel by a blacksmith.

Cold chisels.—For general-purpose repairing an assortment of various sizes of cold chisels should be kept on hand. These tools belong in the same class as the punches and can either be purchased or made from tool steel. The cost of cold chisels varies according to the amount of steel that they contain, the smaller ones being sold as low as 15 cents and the larger ones from 40 to 60 cents.

A chisel for use in cutting hot iron known as a "hardie" (shown in place on anvil, fig. 12) is designed to fit the square hole in an anvil, the iron being laid upon the upturned edge of the hardie and struck with a heavy hammer. Another type of cutter fitted with a handle is offered by the trade. In using this tool the iron is placed upon the anvil, the cutter is held in position, and the cutting is done by striking with a sledge or heavy hammer. The cutting edge of any chisel for cutting iron requires to be tempered very carefully in order that it may withstand hard usage.

Files.—Both flat and three-cornered files will be required quite frequently in making repairs or improvements to equipment. A large flat file can be secured for 30 or 40 cents, and the small three-cornered ones will cost only 10 or 15 cents each. In securing a large flat file it is desirable that it should not be too fine, one of the flat bastard type being the most serviceable. The three-cornered files can be secured with single or double cutting ends. Square and round, or rat-tail, files are useful for many purposes.

Forge.—There are numerous makes of portable forges on the market, practically all of which are adapted to use on the farm. This type of forge is desirable where it is necessary to do work in several local-

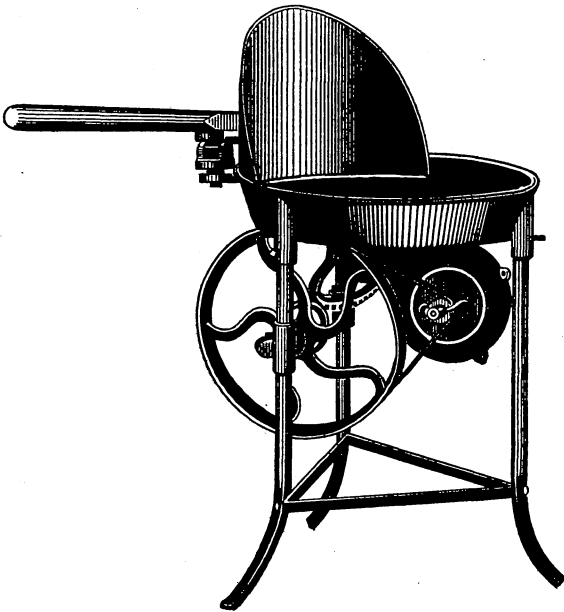


FIG. 11.—Portable forge.

ities; but where the repair work can all be brought to a central shop a stationary forge with rotary blower will be found most satisfactory. Portable forges (fig. 11) can be secured at prices ranging from \$3.50 to \$15, a good outfit being obtainable for about \$8. A blower with connections for a stationary forge can be bought for \$10 to \$15.

Anvil.—Some form of anvil is of as much importance as

the forge. Anvils are made in various sizes and are sold by weight. Two types of anvil are offered by dealers, the one consisting entirely of wrought steel and the other of cast iron with a steel facing. The wrought anvil, although more expensive, is to be preferred to the cast-iron type, as there is no danger of its breaking under heavy forging. An anvil suited to repair work should weigh from 70 to 90 pounds. The cost of a cast anvil will be about 3 cents a pound and of the wrought-steel anvil 10 or 11 cents a pound.

Where no regular blacksmith outfit is maintained, a combination vise and anvil will be found fairly satisfactory. The anvil should be mounted on a heavy block of wood, but in order that it

may be moved when necessary it should not be anchored to the floor.

Blacksmiths' hammers.—A forging hammer weighing about 2 pounds will be desirable for working hot iron on the anvil. This tool will cost from 80 cents to \$1.

Where considerable heavy ironwork is to be performed, it will be desirable to secure a sledge hammer weighing about 8 pounds, to be used by the person assisting the blacksmith. This tool is known as a "striking" hammer. The cost of an 8-pound sledge complete with handle will be about \$1.

Tongs.—At least two pairs of tongs will be required for blacksmith work. If more than two pairs are provided the collection should include those having broad, flat jaws, also straight and curved-lip tongs. The size of tongs is determined by their length in inches, the 20-inch length being about right for general purposes. The cost of tongs of this character should not be more than 50 cents a pair.

Vise.—Where considerable forging is to be done a regular blacksmith's vise with wrought-steel jaws is desirable. This type of vise will withstand the heavy hammering necessary to the bending and shaping of iron. For general purposes the cast-iron type known as a bench vise will answer, and this can be procured at a much lower cost than the regular steel vise. A combination pipe-holding and bench vise can be obtained, but the cost of such a tool is almost as great as for both a bench vise and a pipe vise when made separately. A very fair bench vise can be secured for \$3.50, a wrought-steel blacksmith's vise will cost about \$5.50, and a pipe vise that will hold all sizes of piping from 2-inch down to the smallest can be obtained for \$3.

Combination tools (fig. 12) intended to do the work required of a vise, anvil, and drill press are upon

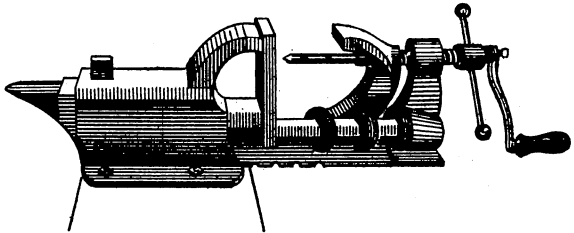


FIG. 12.—Combination vise, anvil, and drill.

the market, but the separate tools will always be found most convenient and durable. A combination tool of this character can be obtained for about \$4.

Drill press.—Where extensive repairs are to be undertaken, there is no part of the repair outfit more desirable than a good drill press. The possession of some device by the use of which bolt and rivet holes may be drilled in metals renders possible the repair of almost any broken part of an implement. There are several forms of drill-

ing machines upon the market, but a standard drill press (fig. 13) will prove most satisfactory. A machine of this class is suitable for all ordinary purposes and can be secured, exclusive of drills, for about \$10. There is a great difference in the quality of drills, but a fairly good set including $\frac{3}{16}$, $\frac{1}{4}$, $\frac{3}{8}$, $\frac{7}{16}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, and 1 inch sizes can be secured for about \$5, making the price of the whole outfit \$15. A lower priced outfit is obtainable, but the drill press is a machine which with proper care should last a long time, and it pays to secure a good one.

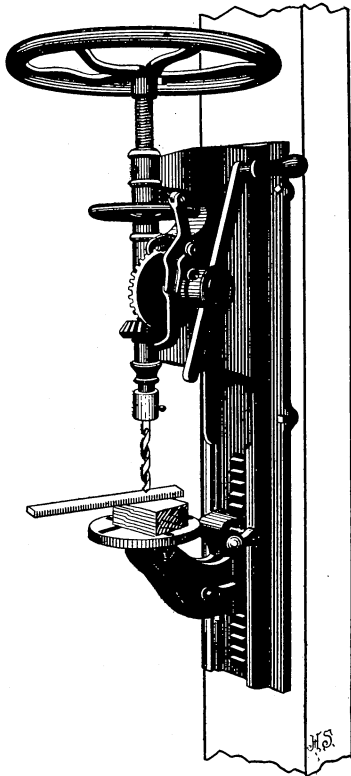


FIG. 13.—Standard drill press.

As a rule the drill press is designed for mounting on a solid post, preferably a support of the building in which the shop is located. In operating the drill press place a small block of wood upon the bedplate and beneath the metal to be drilled. Before starting to turn the drill see that its point is in the center-punch mark, which indicates the location where the hole is to be drilled, and that everything is both level and solid. The drill should be turned slowly and fed downward with regularity. Care must be taken when the drill breaks through the metal that the drill itself does not bind and become broken. When drilling holes in pieces of metal that are too short for holding firmly with the hand, a clamp should be used and the piece of metal fastened firmly to the bedplate.

No one except an expert at grinding should attempt to sharpen the drills, as they must be ground to a particular bevel in order to cut properly. It is best to take them to a machine shop from time to time and have them dressed. Certain drills, such as $\frac{1}{4}$, $\frac{3}{8}$, and $\frac{1}{2}$ inch, are used more often than the others, and it is desirable to have extra drills in these sizes on hand.

In boring wrought iron or soft steel plenty of good oil should be used upon the drill to prevent its heating. Hard steel should not be drilled, or at least not without first removing the temper. Cast iron, brass, and composition metals can be drilled without the use of oil. Always make an indentation with the center punch before starting to drill a

hole; this provides a starting point for the drill and insures getting the hole in the proper place.

Ratchet drill.—The place of a drill press may in a measure be filled by the employment of a ratchet drill (fig. 14). This device has the advantage of being portable, and it may also be worked in close quarters where the use of a drill press would not be practicable. In using a ratchet drill as a substitute for the drill press it will be necessary to provide a solid frame for holding it, as shown in figure 14. A common boilermaker's ratchet is obtainable for \$4 or \$5, but the square-shank drills for use with it are more expensive than the common round and taper-shank drills used in the drill press. The ratchet-drill outfit is not adapted for boring holes that are below three-eighths inch in size, owing to the liability of breaking the drills.

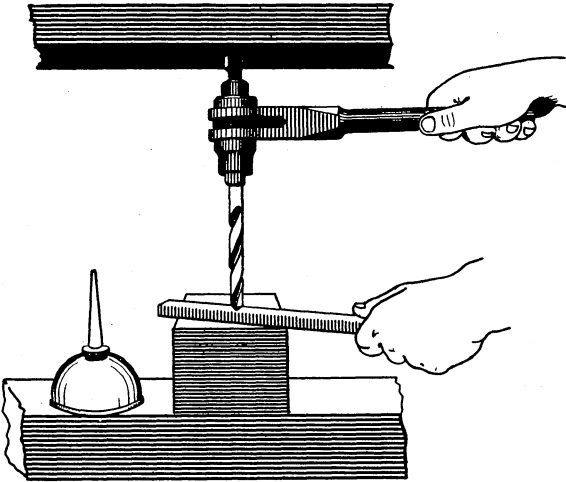


FIG. 14.—Ratchet drill.

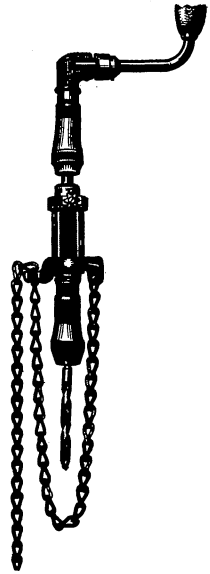


FIG. 15.—Chain drill.

Chain drill.—A small chain drilling outfit which works in an ordinary carpenter's brace is desirable for light work. This device is especially adapted to the drilling of tire-bolt holes and similar work not exceeding three-eighths of an inch in diameter. An outfit of this kind, as shown in figure 15, will cost about \$2 exclusive of drills.

Twist drills.—Regular drills for use in boring metals can be secured having square shanks that fit in an ordinary carpenter's brace. These drills are adapted for boring either wood or metals, and are much more durable for rough work than are the regular wood-boring bits. Twist drills for use in a brace are especially desirable in the smaller sizes. The cost of these drills is from 10 cents upward, according to size and quality.

Hack saw.—Under ordinary circumstances a bar or rod of iron can be cut evenly enough with a hammer and cold chisel, but where exactness is required a hack saw (fig. 16) will be found desirable. As the little blades for cutting iron are very hard and brittle, it is necessary to set them firmly in the frame in order that there can be no

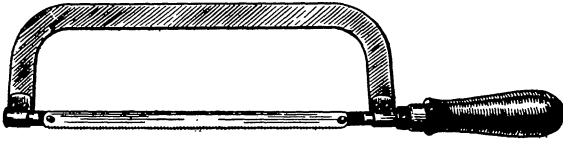


FIG. 16.—Hack saw. The thread for tightening the blade is located in the handle.

chance of bending or buckling. In sawing iron, proceed as in sawing wood, except that slight pressure should be applied in the cutting direction

only. The hack saw should be held firmly with both hands and a uniform movement of about 60 strokes a minute maintained. When the blade becomes worn or broken it may be replaced by a new one. The blades cost 8 to 10 cents each, and extra ones should be kept constantly on hand.

Soldering irons.—For general purposes a 1½-pound soldering iron will be found satisfactory. Where continuous work is to be performed two irons are necessary, in order that one may be heating while the other is in use. Soldering irons should be heated only in a clear charcoal fire or in a blue flame of gas, gasoline, or alcohol. Before using a soldering iron it is essential that the tapering copper point be filed or ground until bright, and then coated with solder by first dipping the brightened hot point into a little of the soldering acid and afterwards rubbing over the solder. This process is known as “tinning” the iron, and is necessary in order to make the solder adhere to the copper and spread evenly. The iron must be retinned as often as the coating burns off. Soldering irons are sold by the pound, the price depending upon the market price of copper; however, the ruling price is about 40 cents a pound.

Thread-cutting appliances.—A set of stocks, dies, and taps for cutting threads on bolts and inside of nuts is quite desirable. This combination is termed a “screw plate” (fig. 17) and ordinarily includes all sizes from one-fourth inch to 1 inch. The prices of these tools vary according to make and number of pieces in the set, but a very good outfit can be secured for \$8 or \$10.

A cheaper device, known as a blacksmith’s stock and dies, may be secured for \$2.50 or \$3, but is not as satisfactory as the regular screw plate. In selecting a thread-cutting outfit care should be taken that the pitch of thread corresponds to that used on standard bolts and nuts.

Pipe-fitting appliances.—With improved water-supply and plumbing fixtures it is possible for farmhouses and adjacent buildings to be

equipped with modern conveniences. The work of installing the plumbing fixtures can all be done by the aid of a set of tools adapted to handling pipe and fittings. A set of pipe-fitting tools is essential to the employment of pipes in the installation of modern sanitary fixtures in dairy barns. A complete outfit for cutting, threading, and working pipe in sizes varying from one-fourth to 1 inch will cost

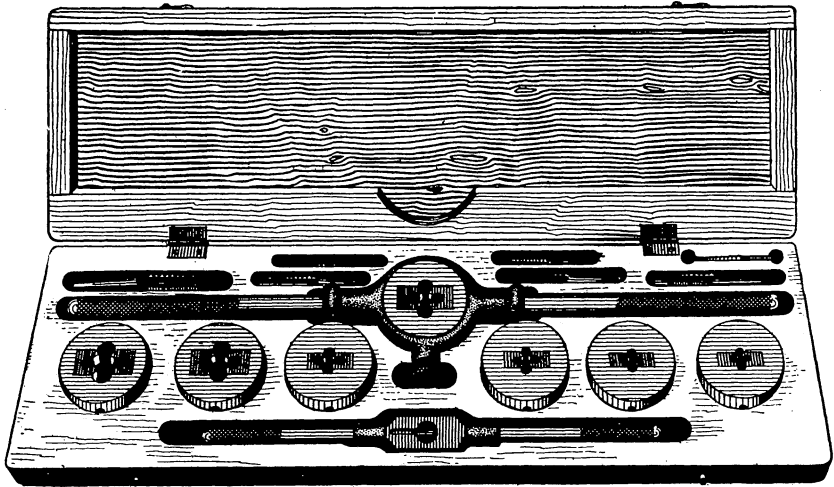


FIG. 17.—Screw plate.

about \$10 for the simpler kinds of tools, and these answer every requirement. This outfit would include stocks and dies, a pipe cutter, a pipe vise, and two wrenches. It should be borne in mind that in stating the sizes of pipes the inside, instead of the outside, diameter is given. The thread used on piping is different from that employed on bolts; consequently the dies for one are not adapted to threading the other.

MISCELLANEOUS TOOLS.

There are a number of tools adapted to the handling of both wood and metals required in general repair work about the farm.

Tinners' snips.—A small pair of tinners' snips, or shears, is desirable for cutting all kinds of sheet metals that may be required either for repair or construction work. The size of these shears is determined by the length of their jaws in inches. A $2\frac{1}{2}$ or 3 inch size is desirable and should cost between \$1 and \$1.50.

Small vise.—A small bench or table vise having about a $2\frac{1}{2}$ -inch jaw is useful for many purposes, especially where the objects to be held are quite small. This tool is also desirable for mending harness in case a regular harness clamp is not available. A vise of this charac-

ter will cost all the way from 50 cents to \$1.50, according to size and quality.

Dividers.—The little implement known as dividers, or compasses, is desirable for drawing circles or segments of circles in the making of special parts of machinery from wood. The cost of a pair of dividers with a segment and set screw for setting to any angle should not be more than 60 cents.



FIG. 18.—Pliers.

Pliers.—Some form of pliers for working wire is essential. Besides their use for handling wire a good pair of pliers is desirable for a great many lines of repair work. There are a number of styles of pliers on the market, but one of the simpler types (fig. 18) will give the greatest amount of service. As a rule a very serviceable pair of pliers can be secured for about 60 cents.

Cutting nippers.—A pair of heavy cutting nippers with circular jaws is useful for many purposes, especially for removing a shoe from the foot of a horse or for trimming the edge of a broken hoof. Where a horseshoeing outfit is maintained, the cutting nippers will be included.

Crowbar or pinch bar.—A crowbar or pinch bar will be found useful on the farm for prying or moving heavy objects. Where stones are to be removed from the soil a bar of this character is almost indispensable. A bar for general purposes weighing about 20 pounds will cost from \$1 to \$1.50.

Maul, or beetle.—A maul, or beetle, can be hewn from a gnarly piece of hickory or gum. The head portion of the maul should be about 9 inches in length and 6 or 7 inches in diameter. Through the middle of this block a hole about $1\frac{1}{2}$ inches in diameter is bored and a shaved hickory handle inserted, forming a mallet weighing 16 to 25 pounds. If extra-heavy work is to be done, the head can be reenforced by means of iron rings, which are put on while hot and shrunk into place. This tool is desirable for driving heavy stakes and similar work.

Grindstone.—The farm repair outfit will not be complete unless some form of grindstone is included. The old type of stone with its wooden shaft, crank, and bearings has largely been replaced by the light-running treadle grindstones. No part of the repair work is so important as the keeping of tools in good order, and proper facilities for sharpening are essential. A good stone, mounted ready for use, will cost about \$3.50.

Oilstone.—The oilstone is a necessary adjunct to the grindstone, its use being to put a smooth edge on the tools after grinding. Chisels, the bits of planes, and similar tools require grinding only occasion-

ally, but may be sharpened quite frequently on the oilstone, and a fine cutting edge maintained. Instead of water, use kerosene or any light oil on the oilstone and wipe off clean when through sharpening. Oilstones can be bought at prices from 60 cents to \$1.

Oiler, or squirt can.—This device is a convenience about the shop, both for oiling machinery and for keeping tools in order. A small oiler is desirable for use in connection with the oilstone. A can of this character will cost from 10 to 40 cents according to quality. In purchasing an oiler care should be taken to secure one having a folded seam where the bottom is joined to the main portion, as a soldered seam is liable to give out in a short while. It is also essential that the bottom should have plenty of "spring" to force the oil from the spout.

Wire stretcher.—On farms where wire fencing is employed it will be necessary to provide an appliance for stretching lines of wire. For light work, where short runs of single wire are to be handled, one of the hand-lever stretchers will be found most satisfactory. This tool consists of a wood lever about three feet in length, about one-third the distance from one end of which is attached a pair of grips or pliers to hold the wire. The wire is gripped in the holder, the short end of the lever passed around the post, and the power applied to the handle. A stretcher of this type can be purchased for about 75 cents.

Another form of stretcher consists of a wire grip to which is attached a ring through which an ordinary crowbar may be passed to serve as a lever. This type of grip is obtainable for about 50 cents.

Staple puller.—A staple puller is essential to the repair or alteration of wire fencing. An old mower guard will serve for this purpose, but a more satisfactory device may be constructed from a piece of $\frac{3}{4}$ -inch steel rod, about 15 inches in length, by drawing one end to a point, then turning about $1\frac{1}{2}$ inches of this point at a right angle to the main portion. In using this tool the point is driven behind the staple by means of a hammer, then by a prying movement the staple is easily drawn. The handle end of the clawbar (fig. 4) may be shaped for use in drawing staples.

HARNESS-REPAIR OUTFIT.

The tools and facilities required for keeping harness in repair are comparatively simple and inexpensive. Many of the parts of harness, together with convenient supplies with which to make repairs, are now offered at reasonable prices by dealers everywhere. A considerable portion of the repair work on harness can be performed by the aid of tools required for other purposes, but there are a few special devices that are desirable.

Leather punch.—A good leather punch is one of the most desirable implements both for repair work and for making alterations in

harness to fit animals of different sizes. A leather punch made somewhat on the order of a pair of pliers and having four or more punching tubes of various sizes is most desirable. It can be secured for about 40 cents.

Rivet set.—A rivet set is especially desirable for use in connection with solid copper or coppered steel rivets. This (fig. 19) is made of a small piece of tool steel and is provided with a small hole for driving down the washer on the rivet, also a countersink for expanding the end of the rivet.



FIG. 19.—Rivet set.

Riveting machines.—There are upon the market several kinds of lever devices for use in the insertion of hollow or tubular rivets in leather. These riveting machines are comparatively cheap, but as a rule the hollow rivets do not hold so well as the solid rivets.

Awls.—For the repair of driving harness there should be kept on hand one or two awls to be used in making the holes for sewing with a waxed thread. Awls of this character can be purchased for about 10 cents each, including handle.

Harness clamp.—A clamp of some character is desirable for holding parts of harness while repairs are being made upon them. For this purpose a small table vise may be employed or a regular steel or wooden clamp may be purchased. A very serviceable homemade clamp may be constructed from two pieces of wood shaped somewhat like the staves of a barrel; at one end these pieces are dressed off so that they will fit together like the jaws of a vise, and the opposite ends may be hinged together or they may be fastened firmly to the sides of a base block. A short distance from the clamping end a screw, a bolt, a leather strap, or some other simple device may be used to draw the jaws tightly together.

SPECIAL CONVENIENCES.

In addition to the outfit of tools obtainable from a hardware dealer, there are a number of special devices that may be made on the farm and which will prove of great assistance in general repair work. Among the more important are the following:

Workbench.—A workbench of some kind will probably be the first essential. A good type of workbench is shown in the foreground of figure 21; also in cross section in figure 20. For the construction of this bench there will be required four boards seven-eighths inch thick, 12 to 14 inches wide, and about 12 feet in length. The length of the bench, however, will depend upon the size of the shop or other space that may be available for use as a workroom. Two pieces of 2 by 4

inch scantling, each 16 feet long, will be sufficient to construct the framework of the bench. All lumber entering into the construction of the workbench should be thoroughly seasoned and dressed to uniform width and thickness.

A clamp for holding materials should be constructed from a piece of hard wood and attached by the aid of a carpenter's bench screw, as shown in cross section in figure 20. This clamp should be provided with notches or pin holes at the lower end, so that it can be set to hold materials of any thickness. Along the front of the bench, two

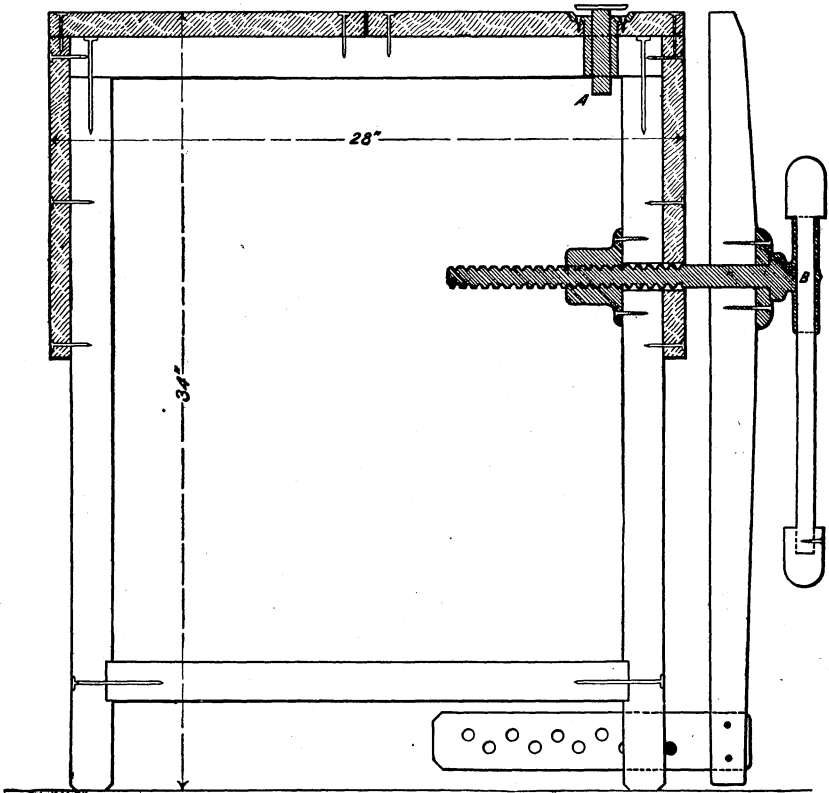


FIG. 20.—Cross section of workbench: A, planing stop; B, bench screw.

or three holes should be provided, into which pins may be set for supporting boards or other materials that are too long to be held rigid by the clamp alone.

A "stop" for holding materials that are to be planed can be inserted in the top of the bench, near the left-hand end, as shown in figure 20. If a regular stop is not employed, its place may be taken by a small piece of notched board nailed on top of the bench.

Sawhorses.—A pair of trestles, or sawhorses, each consisting of a piece of 2 by 4 inch or 2 by 6 inch timber, about 4 feet in length, sup-

ported upon four legs, as illustrated in the foreground of figure 21, are very convenient for working upon while marking, sawing, boring, or chiseling. The sawhorses are an accessory to the workbench and should be constructed at the same time. The cost of materials with which to construct both the workbench and sawhorses should not exceed \$5.

Miter box.—Among the accessories to the workbench there is perhaps no device that will give greater satisfaction than a good miter box to be used for sawing small wood materials either square or at an angle. For the construction of a miter box, three pieces of board 1 inch thick, 6 inches wide, and 3 feet in length should be selected and nailed together in the form of a square trough, taking care that the nails are driven well out toward the edge of the boards. Vertical cuts are sawed down through the sides to the bottom board to guide the saw when the box is in use. Near one end a cut is made at right angles with the length of the box to be used in making square cuts. For making bevel cuts for a right-angled miter joint, the sides of the box should be sawed down on oblique lines running at an angle of 45 degrees with the length of the box. Two such cuts should be made and should cross each other at the middle of the box, forming a letter X. In marking the box to make these cuts, the square should be laid flat on top of the box so that its corner is flush with the outer edge on one side, and each arm reaching obliquely across the box will show exactly the same number of inches to the outer edge on the other side. When the square has been correctly placed, mark along one arm for one of the cuts; then reverse the position of the square and mark for the other cut. A miter box is shown on top of the workbench in figure 21.

COMBINATION TOOL OUTFITS.

For the benefit of those contemplating the purchase of tools for use on the farm the following combinations are suggested. In making up these lists of general-purpose repair tools the better grades have been placed in the higher priced sets, although those included in the cheaper outfits should be of good and durable material.

A \$2.50 outfit.—A hatchet, a handsaw, a small square, a screw-driver, and a pair of pliers.

A \$5 outfit.—A hatchet, a 26-inch handsaw, a small steel square, a drawing knife, a brace and four bits ($\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, and 1 inch), a pair of pliers, a screw-driver, a cold chisel, a flat file, and a monkey wrench.

A \$10 outfit.—A hatchet, a hand ax, a 26-inch handsaw, a 24-inch steel square, a drawing knife, a brace and six bits ($\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, and 1 inch), a pair of pliers, a screw-driver, a cold chisel, a 12-inch flat file, a monkey wrench, a jack plane, 2 chisels ($\frac{1}{2}$ and 1 inch), a rivet punch, a riveting hammer, a leather punch, and a small oil can.

A \$15 outfit.—An ax with handle, a hand ax, a hatchet, a 26-inch handsaw, a 24-inch steel square, a drawing knife, a brace and six bits ($\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, and 1 inch), 3 twist drills ($\frac{3}{16}$, $\frac{1}{4}$, and $\frac{3}{8}$ inch, with square shank to fit in carpenter's brace), a bit gimlet, a screw-driver, a jack plane, a pair of pliers, 2 chisels ($\frac{1}{2}$ and 1 inch), an auger ($1\frac{1}{2}$ inch, with handle), a small vise, a cold chisel, a monkey wrench, a rivet punch, a claw hammer, a riveting hammer, a leather punch, a compass saw, a spirit level, an oil can, a 12-inch flat file, a 12-inch wood rasp, 2 small three-cornered files, a 2-foot folding rule, a chalk line, and a ball of chalk.

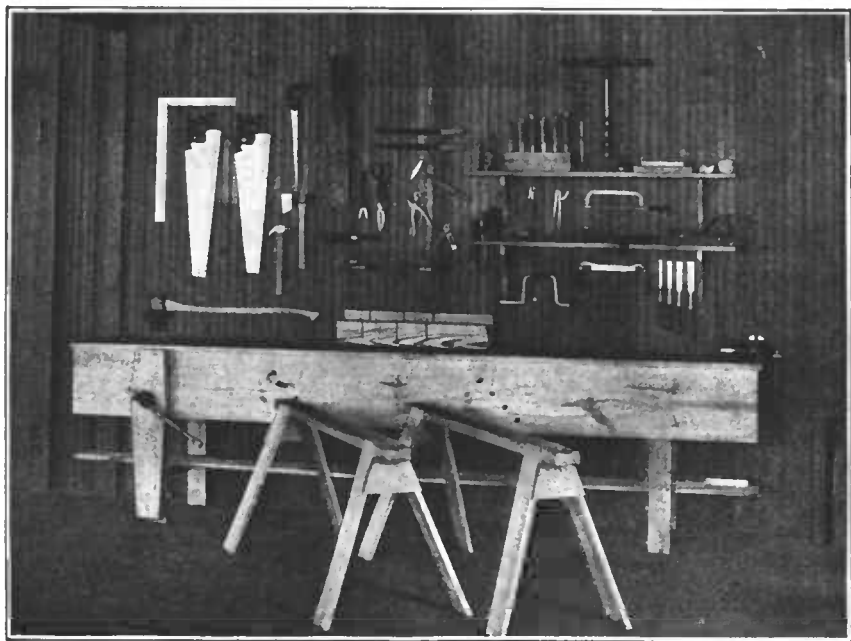


FIG. 21.—Interior of workshop, with \$25 outfit of tools, a workbench, sawhorses, and miter box.

A \$20 outfit.—To the list given for the \$15 outfit, add the following: A 26-inch ripping saw, a spokeshave, a bevel square, a scratch gauge, a pair of dividers, a small try-square, a scratch awl, 2 twist drills ($\frac{1}{2}$ and $\frac{5}{8}$ inch), an oilstone, and a pair of soldering irons.

A \$25 outfit.—To the list given for the \$20 outfit add the following: A small steel square, an alligator wrench, a hack saw, a 10-inch pipe wrench, a pair of tinner's shears, a ratchet brace instead of a plain brace, a rivet set, additional bits to make a full set of 12 ($\frac{1}{4}$ inch to $1\frac{1}{4}$ inches by eighths and sixteenths), and a smoothing plane. A \$25 outfit is shown in figure 21.

IRON-WORKING AND SHOP EQUIPMENT.

Blacksmithing tools.—A blacksmith's outfit adapted to the requirements of a large farm should include a forge, an anvil, a 2-pound hammer, an 8-pound sledge, a riveting hammer, two pairs of tongs, an assortment of punches, hot and cold chisels, anvil hardie, cutting nippers, coarse files, screw plate, vise, drill press with drills, and a monkey wrench. The cost of this outfit may be as low as \$30 or as high as \$60 and upward, according to the class of materials selected. "Combination outfits" consisting of the above tools are offered at these prices, but if the outfit is made up by selecting from the general stock of a dealer, the price paid will be much greater.

Shop equipment.—The complete equipment of a shop for the making of general farm repairs should include the above blacksmithing outfit, the \$25 collection of wood-working and general-purpose tools, a pipe-working combination, miscellaneous tools, harness-repair outfit, a workbench, a pair of sawhorses, and a grindstone. This entire equipment for a shop can be secured for about \$100 in a fair quality of goods, and for \$150 tools of excellent quality can be obtained.

SHOP FACILITIES FOR REPAIR WORK.

A shop or other suitable place where repair work can be carried on during cold or stormy weather is almost as important as the tools and materials with which to make the repairs. A small building devoted exclusively to shop purposes is desirable, but where this is not available a portion of one of the regular farm buildings may be utilized. One side of a wagon shed can frequently be devoted to this purpose. A workbench can be fitted up and provision made for the care of tools and supplies.

Plan of workshop.—A shop which meets the requirements of the general farm is illustrated by the floor plan shown in figure 22. The shop from which this plan was taken consists of a one-story building about 24 feet in length and 16 feet in width, having a plank floor over about two-thirds of its area, the remainder with an earth floor being used as a blacksmith shop. The floored portion was provided on the one side with a wood-working bench, over which were placed several shelves for the reception of tools. On the opposite side there was provided a heavy plank bench with a vise and other equipment for working iron. Below the iron-working bench there should be provided a rack upon which to store the stock of various sizes of square and round iron required for making repairs. Above the iron-working bench there should be a few shelves for the storage of tools; also numerous pigeonhole boxes for the accommodation of the stock of bolts, nuts, and washers.

This shop was constructed of cheap lumber, the siding being put on up and down with cracks battened, and it has a simple gable roof. By this type of construction ample space is secured overhead for the storage of materials, especially seasoned timber for use in making repairs. An abundance of light is essential to good work, and as much of the repair work will be done during dark and cloudy weather, the windows should be numerous and so distributed as to provide for uniform lighting. The windows should be protected on the inside by wire netting.

The large doors in the end of the shop are made to cover the entire space between the workbenches, so that the larger farm implements may be brought upon the floor for repairing. Where the climate is cold, provision should be made for a heating stove, in order that the shop may be comfortable for work during winter weather.

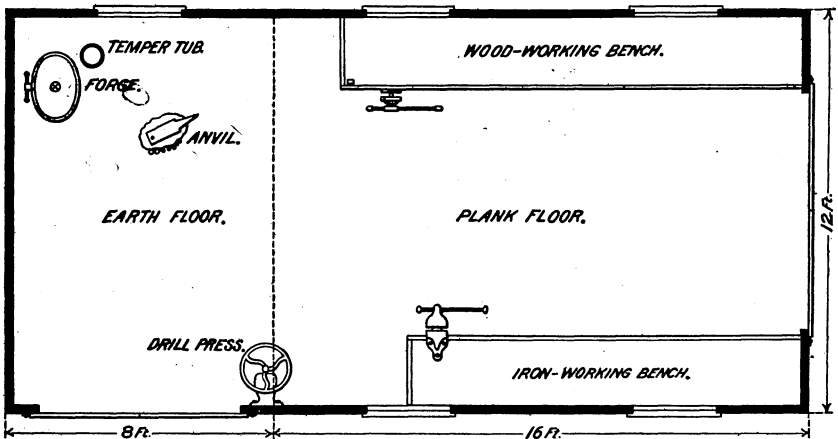


FIG. 22.—Floor plan of workshop.

If a portion of a wagon shed or other farm building is set aside for shop work, it should, so far as practicable, be fitted up the same as a regular shop.

The care of tools.—The system of storing the tools should conform to the needs of those using them and to the work to be performed. In many instances it may be desirable to keep the tools in a portable chest in which they may be carried to any part of the farm or plantation; on the other hand, if the work is done almost entirely at the shop the tools will be more accessible when supported on the walls or upon shelves above the bench.

In climates where the atmosphere is moist the greater part of the time, it is not wise to keep the tools exposed by hanging them on the walls or laying them upon open shelves, but a wall cabinet or a tool

chest should be provided. It should be the aim to have a place for every tool, and then cultivate the practice of returning it to its proper place immediately upon the completion of the work in hand. A very good plan for keeping the tools in their respective places is to first draw an outline of each tool in its place upon the wall and then

- paint this space black or some color in contrast with the wall itself, so that when any tool is not in its place its absence will be readily apparent.

Many persons are in the habit of leaving tools where they finish using them. In the first place, a tool can not be kept in working condition if allowed to remain exposed to the weather, and in the second place the time lost in locating the tool when it is next required for use will be much greater than that which would be required to return it to the proper place.

MATERIALS REQUIRED FOR GENERAL REPAIR WORK.

However complete the tool equipment, it will be of little use without a supply of materials with which to replace worn or broken parts of machinery and implements. The time required to secure stock materials may be as great as that necessary to have the repairs made in the nearest shop. A supply of timber, bar iron, bolts, rivets, screws, etc., should be kept constantly on hand and renewed from time to time as the stock runs low.

WOOD MATERIALS FOR REPAIRING FARM EQUIPMENT.

The supply of wood for use in making repairs should be well seasoned and dry. It should include split hickory, ash, and oak, from which handles, singletrees, doubletrees, neck yokes, and similar articles can be made. Split timber is better than sawed for these purposes, owing to the straight grain when the wood is split. Sawed oak, ash, or heart pine, in sizes 1 by 2, 2 by 4, 2 by 6, 3 by 4, 3 by 6, 4 by 4, and 4 by 6 inches, and 14 or 16 feet in length is frequently required for use in replacing broken handles, braces, tongues, axles, etc. It is also desirable to have on hand a small stock of white pine, one-half and seven-eighths inch in thickness, for use in repairing or replacing the lighter wood parts of implements.

A great variety of wooden parts for farm implements is kept in hardware and general supply houses. On large farms it is advisable to keep on hand one or two each of the following: Ax handles, hatchet and hammer handles, hoe and rake handles, fork handles, shovel handles, singletrees and doubletrees, wagon tongues, carriage poles, and buggy and wagon shafts.

It should be the practice to save every small piece of good material and store it in a dry loft or other convenient place. A good piece of a thin board can frequently be saved from a broken packing box, and this will serve as well as new material for repair work. It should be the policy to save every good barrel hoop or extra barrel head for future use in replacing a broken or missing one. Very little time will be required to care for these articles if some system of storing them is employed.

METAL MATERIALS FOR REPAIRING FARM EQUIPMENT.

Bar Iron.

Where a regular blacksmith outfit is maintained the supplies kept on hand should include a stock of both round and square iron. The bars come in lengths of about 14 feet.

Round iron bars.—The stock should include the following: $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, and $\frac{3}{4}$ inch, three to five bars each, and one bar 1 inch in diameter. The $\frac{3}{8}$ and $\frac{1}{2}$ inch sizes are most frequently needed.

Rectangular iron bars.—The stock should include the following sizes: $\frac{1}{8}$ by $\frac{3}{4}$ inch, $\frac{1}{8}$ by 1, $\frac{1}{4}$ by 1, $\frac{1}{4}$ by 2, $\frac{3}{8}$ by 1, $\frac{3}{8}$ by $1\frac{1}{2}$, $\frac{3}{8}$ by 2, $\frac{1}{2}$ by 1, $\frac{1}{2}$ by $1\frac{1}{2}$, $\frac{1}{2}$ by 2, and $\frac{1}{2}$ by 3 inches. The greatest demand will be for $\frac{1}{4}$ by 1 inch, $\frac{1}{4}$ by 2, $\frac{3}{8}$ by $1\frac{1}{2}$, and $\frac{1}{2}$ by 2 inches, and of these sizes three or four bars should be secured. Of the other sizes one or two bars will usually suffice.

T-bars and angle iron.—These in sizes up to $2\frac{1}{2}$ inches are very useful for making repairs on harrows, cultivators, and other implements in the construction of which such iron has been used.

The price of bar iron varies with the market, but it is usually less than \$3 per hundredweight.

Iron Bolts.

For the convenience of intending purchasers, a list of bolts is given. The sizes most needed in repair work are indicated by the larger numbers suggested. For information concerning prices, dealers or their catalogues should be consulted, as the prices vary with locality and market conditions. Bolts, screws, and rivets can be secured at a great reduction if purchased in original packages containing 50 or 100, or a gross, as the case may be.

Carriage bolts.—As a rule the round-headed or carriage type of bolt is best adapted for use in wood or where wood and iron are bolted together. Whenever a nut is being drawn down upon wood, a washer should be placed beneath it. A hole bored for the insertion of a carriage bolt should not be more than one-sixteenth inch larger than

the bolt, as the square shank of the bolt should be driven solidly into the wood to prevent its turning. The difference between machine and carriage bolts is shown in figure 23.

The supply of carriage bolts should include the following: 100 each of $\frac{1}{4}$ by 2, $\frac{1}{4}$ by 3, and $\frac{1}{4}$ by 4 inches; $\frac{3}{8}$ by 2, $\frac{3}{8}$ by 3, $\frac{3}{8}$ by 4, and $\frac{3}{8}$ by 6 inches; $\frac{1}{2}$ by $1\frac{1}{2}$, $\frac{1}{2}$ by 2, $\frac{1}{2}$ by 4, and $\frac{1}{2}$ by 6. Of the following sizes a dozen each should be secured: $\frac{1}{2}$ by 8, $\frac{1}{2}$ by 10, and $\frac{1}{2}$ by 12 inches.

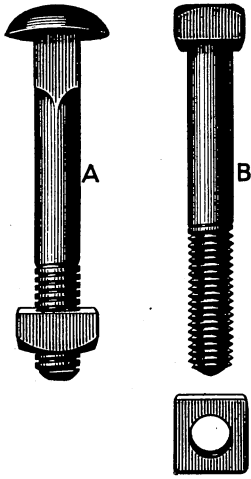


FIG. 23.—Bolts: A, carriage bolt; B, machine bolt.

Machine bolts.—These have square heads but the shanks are round throughout. For bolting together iron parts, they should always be used. The following will make a fair supply for a farm: 100 each of $\frac{3}{8}$ by 2 and $\frac{3}{8}$ by 4 inches; $\frac{1}{2}$ by $1\frac{1}{2}$, $\frac{1}{2}$ by 2, $\frac{1}{2}$ by 3, $\frac{1}{2}$ by 4, and $\frac{1}{2}$ by 6 inches; $\frac{5}{8}$ by 2 and $\frac{5}{8}$ by 4 inches. A dozen each of the following should be included: $\frac{1}{2}$ by 8 and $\frac{1}{2}$ by 10 inches; $\frac{5}{8}$ by 6, $\frac{5}{8}$ by 8, and $\frac{5}{8}$ by 10 inches; $\frac{3}{4}$ by 3, $\frac{3}{4}$ by 4, $\frac{3}{4}$ by 5, $\frac{3}{4}$ by 6, $\frac{3}{4}$ by 8, $\frac{3}{4}$ by 10, $\frac{3}{4}$ by 12, and $\frac{3}{4}$ by 14 inches.

Tire bolts.—Bolts either $\frac{3}{16}$ or $\frac{1}{4}$ inch in diameter and from $1\frac{1}{2}$ to 2 inches in length are most used. Examine the wheels of the vehicles which are to be kept in repair, and get two or three dozen of each size of bolts needed. A few felly plates should be included.

Extra nuts.—To replace lost nuts, the following should be included in the stock: 25 each of $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, and $\frac{3}{4}$ inch sizes.

Washers.—For use with bolts and rivets, get 2 pounds each of the $\frac{1}{4}$ and $\frac{3}{8}$ inch sizes, and 5 pounds each of the $\frac{1}{2}$ and $\frac{3}{4}$ inch sizes.

Rivets, Screws, Nails, Etc.

Iron rivets.—For most purposes rivets with small round heads or with broader flat heads are used. The sizes most needed are $\frac{3}{16}$ and $\frac{1}{4}$ inch in diameter and $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{3}{4}$, and 1 inch in length. From a half pound to a pound of each size will be an ample supply. Rivets with countersunk heads are used for some purposes, and a few of the different sizes should be secured; also a few of the special rivets used in repairing mower and reaper knives.

Wood screws.—Screws are classified by number and length, the number referring to the diameter. They are put up in boxes each containing one gross. A gross each of the following sizes should cost about \$2, and will meet all ordinary demands: No. 6, of $\frac{3}{4}$ and 1 inch lengths; No. 8, of 1, $1\frac{1}{4}$, and $1\frac{1}{2}$ inch lengths; No. 10, of $1\frac{1}{4}$, $1\frac{1}{2}$, $1\frac{3}{4}$, and 2 inch lengths; and No. 12, of 2 and $2\frac{1}{2}$ inch lengths.

Nails.—Of flat-head wire nails, 5 pounds each of 3, 4, 5, and 6 penny sizes and one keg (100 pounds) each of 8, 10, 20, and 40 penny sizes should be obtained. Nails purchased in small quantities will cost 4 and 5 cents a pound, but if secured by the keg the cost is generally below 3 cents a pound. For certain purposes, such as the laying of floors and the construction of partitions from matched lumber, the square cut steel nails are considered desirable. Wire brads of various sizes and lengths are useful for both repair and construction work, and a few of these of different sizes should be secured.

Staples.—Of the standard size used in the construction and repair of wire fencing, 10 pounds or more should be kept on hand; also a pound or two of the smaller sizes for fastening poultry netting. Small staples, known as "double-pointed tacks," are useful for tacking fly screen over windows and for many other purposes.

Strap hinges, clips, wire, tin, etc.—On farms that are at a distance from a hardware store, a few pairs of strap hinges of 3, 4, 6, 8, 10, and 12 inch lengths should be kept in stock. Hooks and staples or iron latches for fastening gates and barn doors may also be included in the hardware list. Clips for singletrees, doubletrees, and neck yokes are offered by dealers at prices far below the cost of having them made at a local shop. Other materials that may often prove useful are small copper wire, annealed wire, galvanized wire, hoop iron, galvanized sheet iron, and sheet tin.

SUPPLIES FOR REPAIR OF HARNESS, CARRIAGE TOPS, ETC.

Every farmer should have on hand supplies for the repair of harness, and many will find it an advantage to have also some materials for making the simpler repairs on carriage and buggy tops. Ready-made harness and bridle parts of all kinds can be secured from many of the larger establishments.

Harness rivets.—The solid rivets for harness repairs are either of copper or coppered steel, the former costing about three times as much as the latter. They can be bought in boxes containing assorted lengths ranging from one-fourth to three-fourths inch.

Leather.—By visiting a regular harness shop, it is often possible to secure at a small cost scraps of harness leather that will prove very useful in making repairs; but where the amount of repairing to be done is large, the purchase of a whole side of good harness leather is advisable.

Harness hardware.—The supplies of this class most often required are buckles of various sizes, snap hooks, bridle bits, hame staples, hame clips, cockeyes, open links, and rings of different sizes.

Other materials.—The outfit should also include thread, beeswax, extra awls and needles, carriage washers, knobs and eyelets for car-

riage curtains, shaft tips, and harness oil. A broken shaft may often be made good with a metallic shaft end. There are also on the market a number of devices, known as "menders," for making quick temporary repairs to harness.

PAINTS, OILS, AND MISCELLANEOUS SUPPLIES.

For repainting the farm equipment the following supplies will be found useful: White lead, red lead, Venetian red, raw linseed oil, and turpentine. Ready-mixed paints can be used, but when made of good materials they are more expensive. For lubrication purposes there should be a supply of machine oil, axle grease, and castor oil. For miscellaneous purposes there will be required small quantities of liquid glue, rubber cement, solder, soldering fluid (prepared by adding metallic zinc to strong hydrochloric or muriatic acid), sandpaper, emery cloth, and twine.

SUGGESTIONS.

The lists contained in this bulletin include many things that will not be required on a large number of farms. Where specialized farming is pursued, only the tools and supplies with which to repair the special farm equipment will be required. The indiscriminate purchase of tools may result in direct loss.

In deciding what tools and materials to purchase, always give preference to those most frequently and urgently needed, passing over those that will be rarely used.

Keeping a machine or vehicle in good repair and well oiled not only increases its efficiency, but lessens the power required in using it.

The proper maintenance of farm machines not only saves money but avoids danger to those who operate them. Keeping the harness and vehicles in repair may prevent a dangerous runaway.

So far as practicable let the repair work be done when regular farm work is not pressing, as on rainy days and during the winter season. Pursue the repair work as a kind of recreation or rest from the regular farm operations.

Do not have several places for the storage of repair tools and supplies. Have one convenient place, and see that all tools are kept there when not in use.

Tools and materials should be kept in their proper places. Do not keep all sizes of bolts or screws mixed together in a single receptacle, but fit up suitable boxes or bins, so that the supplies may be accessible on short notice.

Keep all tools clean and free from rust, and all edge tools sharp.